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Editor:
MICHAEL GELFAND, C.B.E., M.D., F.R.C.P.

Assistant Editor:
JOSEPH RITCHKEN, M.D.

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Sociological Patterns and Their Influence on the Transmission of Bilharziasis

BY

E. L. HUSTING

1604 Marconi Road, Belmar, New Jersey.

Only in recent years has it been recognised that the behaviour of many organisms, including humans, is regulated to the extent that patterns may be described quantitatively, and that useful generalisations may be produced.

The transmission of bilharziasis depends entirely upon human activities. Infection requires that humans seek out and contact water which contains snail vectors producing cercariae.

Contamination resulting in the continued infection of snails depends upon the use of snail habitats for urination and defaecation by humans. Bilharzia may be considered to be water pollution. It is the result of pollution of natural waters with infected faeces and urine. It is a form of pollution as real as other forms of biological contamination, such as by pathogenic bacteria found in sewage.

Mozley, working in Rhodesia in 1944, pointed out that bilharzia in the poorer classes in Rhodesia "was an inevitable result of their place of residence and mode of life". He coined the phrase "the snails were the messmates of man", and described the situation as, in his opinion, "alarming".

Blair, discussing the situation in 1948, noted the increase in bilharzia, and stressed the need for developing boreholes and wells which would be more accessible than natural waters. He also mentioned the need for facilities for ablution and laundering.

Questions which needed to be answered about human behaviour included:

What age groups have the most contact?
Do males or females have more contact?

What activities are implicated most frequently?

What is the relationship between frequency of contact and duration of contact?

Is contact a social activtity?

Are there seasonal or diurnal variations in contact?

What beliefs, attitudes or customs are responsible for contact patterns?

Is contact more or less random, or is it largely a function of social role and status in the community?

The most intensive and extensive published study of sociological aspects of schistosome transmission comes from the Egypt 49 project. It was published in the Bulletin of the World Health Organisation in 1966.

Farooq *et al.* (1966) found that occupation influenced prevalence. The highest prevalences were in fishermen and in boatmen. Farmers had a high rate of infection, as did farm labourers. Christians had significantly lower rates of infection than did Moslems. This was attributed to ablution practices by the Moslems.

Rates of infection were lower in persons who were literate or attending school, and infection decreased as education increased.

The rate of infection was twice as great in persons who swim as in non-swimmers. Persons who washed clothes or utensils in canals had significantly higher infection rates than persons using piped water for the same purpose.

In a separate paper, Farooq and Mallah have discussed the patterns of water contact activities. Information on behavioural patterns was obtained by observing four typical water contact points in the Egypt 49 project area. They recorded the age and sex of all individuals approaching the contact point, and recorded activities under 13 categories.

They divide these categories among those that result in exposure to cercariae, and therefore lead to infection, and those that result in contamination.

They observed 2,248 activities, performed by 2,157 individuals. They found that females had more contact than males with 68 per cent. of the total activities. Washing clothes, washing utensils, and taking water were mostly performed by females. Bathing and playing were performed by both girls and boys. Other activities were performed almost exclusively by males.

Urination and defecation were performed by males of all ages, except that no boys 10 to 14 were seen.

Washing clothes and taking water were activities of adolescent girls and adults. Girls frequently were seen washing utensils. Small girls in the company of their mothers were largely involved in bathing and playing, and were responsible for most observed contamination by females.

Females, especially adolescents and young adults, participated in exposure activities more than six times as often as males. Males were engaged in five times as many contaminatory activities as females.

They conclude that the provision of public drinking water standpipes had not prevented contacts with infected waters.

They found that even partial use of protected water supplies markedly lowered rates of infection.

Their conclusions regarding the presence and absence of latrines were interesting. In the project area, 52 per cent. of the houses had latrines which were in use. Another 10 per cent. of the houses had latrines which were not in use. About 38 per cent. of the housing lacked latrines.

They found that infection rates were lower in persons with access to latrines, and surprisingly this held true even where the latrines were not used. They concluded that the irregular use of latrines by a small proportion of the population had no substantial effect on prevalence.

They suggest that latrine construction "programmes should therefore form part of the community environmental sanitation and educational programme, but not be specially directed against nor debited to, bilharziasis control".

They also conclude that "a more abundant piped water-supply distributed throughout the endemic areas will undoubtedly result in diminishing the incidence of bilharziasis and certain other infections".

A parallel study was undertaken in Rhodesia in 1964 at the suggestion of Dr. Clarke.

There was no quantiative information previously available; however, prevalence studies done by the Blair Research Laboratory had revealed consistently higher rates of infection in females.

Charles Bullock, an early Native Commissioner, writing about "The Mashona" in 1927, gave a good description of the division of labour which still determines water contact patterns in much of rural Rhodesia.

The same author, writing about the Mashona in 1950, some 23 years later, begins his discussion of the woman's part in kraal life in this way: "Wife must carry up the day's supply of water ...."

With this background, observations were begun on the Mazoe Citrus Estate, about 30 miles north of Salisbury. The Mazoe River flows through the estate, and at the contact point observed, the river flows under a bridge.

The contact point is adjacent to a site housing about 50 African labourers and their families.

Limited supplies of water were available for drinking at taps supplied by a windmill.

Tribal groups present in the site came from Mashonaland, Zambia, Malawi and Portuguese East Africa.

The contact point lies downhill from the houses, and is partially obscured by vegetation. The bridge provides shelter for persons wishing to bathe unobserved. The cement foundations of a bridge are used as shelving for wet clothing, dishes, or utensils. Women traditionally use the upstream side of the bridge, whereas men use the downstream side.

We were unable to observe contaminatory activities; however, defecation occurs at night between the housing site and the water. Faecal material is abundant, and is probably washed directly into the river during the rainy season. Defecation and urination during the day are performed where they cannot be observed.

Observations were taken on alternate days from 6 a.m. to 12.30 p.m. and from 12.30 p.m. to 6 p.m.

The age and sex of all arrivals at the contact point were recorded, and data for each group of arrivals was entered separately.

When two activities such as washing dishes and washing clothes occurred together, they were considered as a third distinct activity. Thus the analysis distinguished between "single" and "combined" activities.

Eight hundred and eight-one hours of observation were taken at the Mazoe River during 19 months. The average rate of arrival per hour of observation for females was 3.93 compared to 0.92 for males. The average time per contact was also greater for females, with 45 minutes average compared to 39 minutes for males.

It was anticipated that our presence might have some effect on contact. One measure of this was the relationship between the number of hours of observation time per month, which varied, and the observed rate of arrival, using paired monthly values. It was found that there was a small positive correlation not significant at the 0.05 per cent. level.

In every month of the year females had higher rates of arrival than males. Although the monthly rate of arrival per hour of observation decreased throughout the study the rate of arrival reached peak values in October and November, which have been described as months of intense transmission by other workers in Rhodesia.

Lower rates of arrival were observed during planting in December and January, and during the cool months of June, July and August.

There was an inverse correlation between monthly rate of arrival and average time spent. The explanation for this is that the contact time required per household is fairly constant and may be taken care of in a few long contacts or several short ones. When weather was pleasant, and time permitted, the amount of time spent at the water was increased slightly by social activities.

Women aged 16 to 25 and girls aged 4 to 6, together accounted for 52 per cent. of all female contacts.

Male contacts followed a similar pattern and the same two age groups were responsible for 44 per cent. of all male contacts.

The same two age groups were also responsible for more than half of all female contact time, and for 45 per cent. of male contact time. These two age groups made up only 23 per cent. of the male and 34 per cent. of the female age distributions.

Thus the contribution of these two age groups, both in duration and frequency of contact, was the greatest, and also was in excess of their proportion in the population.

Most of the contacts and contact time of these age groups were taken up by a fewer major activities. Washing dishes was the most frequent female activity, with more than one arrival per hour. Other important activities included removing water and swimming. These three activities — washing dishes, removing water, and swimming — were responsible for nearly 70 per cent. of all female contact. These activities were also responsible for more than half of female contact time.

The three most common male activities were washing the body, swimming, and washing the extremities. These activities took up better than 60 per cent. of all male contact, and better than 70 per cent. of all male contact time.

Although female contacts were more frequent, the male activities involved a greater extent of immersion.

An interesting sidelight is the difference between activities when performed singly in contrast to the same activities when combined. The average time required for washing dishes was 48 minutes, and the average time used while washing clothes was 69 minutes. The average time for the two activities

performed in combination by the same persons should be near the sum of the average time, or about 117 minutes.

The observed average time was actually 75 minutes, or 42 minutes less than expected.

The additional time required to perform activities separately is spent in talking and relaxing. It is recalled that the frequency of contact was inversely related to the average time spent, whereas the total time spent was more or less constant.

There were several peaks of arrival during the day. There were usually female arrivals early in the morning, removing water for breakfast, cooking and washing. A later arrival peak in mid-morning was associated with washing dishes, bathing, and washing clothes. A few women and girls arrived at noon to draw water. Contact in the afternoon was associated with washing dishes, bathing, and removing water for the evening meal.

Men were working during the morning and early afternoon on weekdays, and this limited most adult male contact to afternoon.

A detailed study of the age and sex composition of groups arriving at the water showed that traditional Bantu social relationships were affecting water contact behaviour.

There were frequent associations between girls, and between young girls and their mothers. Pre-adolescent, adolescent and teen-age girls came to the water most frequently with other girls in the same age groups.

Most males appeared with males of their own age. Young boys did not frequently appear with older males, but were seen frequently with girls the same age, and with their mothers, aunts or older women. Males over 13 years old were very rarely seen with females at the contact point.

The percentage of people appearing alone increased with age for both sexes. All of these phenomena can be interpreted as manifestations of sexual maturation, and accompanying Bantu attitudes towards modesty and morality.

The strong tendency for males to associate with persons of their own age may be a remnant of traditional age-grade groups which formerly, and in some areas even today, were initiation groups.

Additional observations were taken on weekends to determine whether the patterns of contact varied. Both the rate of arrival and the average time spent per arrival increased for adult males and for male adolescents. The time of arrival pattern also altered. There was increased female contact between 7 a.m. and 8 a.m. in the morning. The rates of arrival for persons swimming and playing decreased for both sexes, as well as the rates of arrival for several adult female activities, notably washing dishes.

Observations were taken to determine the rate of arrival at the taps supplying drinking water. Water was available in limited amounts, and only when wind was sufficient to operate the windmill. The taps were in operation only 21 hours out of 67 hours of observation. About seven persons per hour visited the taps when they were operating, which was more frequent than any average monthly arrival rate at the nearby contact point.

A series of stool and urine surveys were held in the area to determine incidence and prevalence among age, sex, residential, occupational, and tribal groups.

There were gains and losses of infections in all age groups; however, it was found that net increases in prevalence were observed mainly in the age groups with the most contact, namely the 4 to 6 year olds and 16 to 25 year olds.

There were no observed differences in contact or prevalence attributed to occupation, tribal origin, or residence.

Although the details of behaviour obtained by the Egyptian observers differ greatly due mainly to the large numbers of Muslims in their population, there are basic similarities. In both studies rural water contact was the result of traditional behaviour patterns which are alterable as part of the process of education and urbanisation.

It is difficult to introduce effective sanitation into rural areas, especially when supplied water is not available or is limited. Many townships in Rhodesia are now fitting African housing with the type of latrine known as a water seal. This privy is accepted by Africans. It operates by maintenance of the water level in the pit and there is no flushing action required. Unfortunately, it requires periodic attention and requires maintenance of a large volume of water. Although in theory obnoxious gases are diverted, unpleasant odour escapes from the system.

In some areas of Rhodesia the Chiengmai type of latrine has been installed with success. This is an inverted siphon which flushes with a small volume of water, prevents breeding of flies, is inexpensive, and is easily cleaned. It requires that a supply of water be available, and for best effect users should be provided with a quantity of paper tissue.

Where water is not provided, Chiengmais become fouled, and users may convert them to a simple pit latrine by breaking the bottom of the unit with a piece of metal.

The Report of the Secretary for Health for the year ended 31st December, 1967, summarizes concisely the situation regarding sanitation in Rhodesia. "In view of the widespread pollution of surface waters in this country we are, in fact, fortunate that more serious outbreaks of intestinal disease do not occur; although, of course, this factor is entirely responsible for the high incidence of bilharziasis".

The report continues: "The need to re-settle people from a number of thoroughly insanitary squatter settlements is recognised, and it is accepted that pit latrines of the "Chiengmai" pattern are at least preferable to no latrines at all."

Macdonald (1965) pointed out the extreme difficulty of controlling bilharziasis by preventing contamination. Even a very successful sanitation programme, in terms of reducing the per cent. of stool reaching water, may not be sufficient to stop transmission. Sanitation without personal hygiene will have no effect on contamination by faecal material which adheres perianally.

The problem of sanitation is further complicated by the possible existence of non-human hosts which might provide a reservoir source of schistosome ova.

Control of entry to water is increasingly a problem in rural Rhodesia. Even the smaller rivers are now receiving water management attention, and the construction of many weirs creates a double problem. The dams above weirs are often ideal snail habitat. The area immediately below weirs is ideal for Africans to perform water contact tasks.

Where safe water supplies have been provided, they often receive only limited use because they fail to meet some basic need. Facilities must be close to the community, and preferably closer than natural waters. The supply must be adequate, dependable, and free from pollution. It must appear clean. The facilities should allow for local customs such as the traditonal kneeling position of the Rhodesian Bantu woman when working.

Bathing sites must afford adequate privacy to satisfy modesty; they must be segregated by sex, and must have good drainage. Drying space for utensils, and clothes lines are needed.

Preliminary field work in Rhodesia has shown that it is possible at minimal cost to reduce water contact. It should be recalled that more than half of all contact is limited to two age groups of females mainly engaged in the activities of washing dishes, removing water, and swimming, playing or bathing.

If African women can be induced to use a manually operated pump to remove water, and to wash dishes at a simple ablution block, this alone will cut contact by up to 50 per cent. Where no facilities are available the women risk infection each and every time they wash dishes or obtain domestic water.

Gelfand (1965) has pointed out the strong social pressures which operate within the Mashona tribal groups. These pressures can operate against successful introduction of safe water supplies; however, the same pressures can militate for acceptance of facilities if community leaders can be convinced on the benefits to the community.

In Umsingedzi Purchase Area preliminary surveys of African-owned farms show that in almost every instance where sanitation, bore holes or wells are present, the farm owner has had a period of urban employment which has familiarized him with the use and importance of such facilities.

The increasing mobility of the rural African is often cited as a difficulty in controlling bilharziasis; certainly it is not possible to control isolated areas when adjoining areas or major river systems are not controlled. On the other hand, unpublished data taken by Evans in the Hartley area indicates no significant difference in prevalence between Africans who travel from their place of employment on holidays or weekends and those who do not.

The best experimental proof of the feasability and value of controlling water contacts and of directing such control at important activity and age groups, is the work of Dr. Pitchford.

Results in his paper published in 1966 as a supplement to the *South African Medical Journal* showed that introduction of safe water supplies on the Crocodile Valley Estates decreased the prevalence of bilharziasis in Bantu children.

Both European and African alike must be convinced that water pollution and the resulting problems such as bilharziasis, are unnecessary and undesirable. It must further be impressed on both groups that the eventual control of contaminatory activities is a necessary facet of water management.

In conclusion, I would like to consider two quotations. The first relates to the difference between the sciences of sociology and human ecology, and was published in the December 1968 Newsletter of the Human Ecological Society: "Human Ecology is merely a semantic substitute for sociology and anthropology unless it brings some new and significant element into man's search for an understanding of himself. This element is the conception of human ecology as action oriented".

I suggest that the control of the transmission of bilharzia is a problem of human ecology, which requires modification of both human relationships and ecosystems."

This is entirely in accord with the second quotation, a statement by the Secretary for Health regarding bilharziasis in the report for the year ending 31st December, 1967: "Bilharziasis is a national problem and it is the primary responsibility of those individuals and organisations who create the conditions under which it flourishes. Bilharziasis control must be accepted as part of the job of conserving water and irrigating with it."

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DISCUSSION

Dr. Pitchford: Could you elaborate on the method of faecal pollution; i.e. how the *S. mansoni* miracidium reaches the water and hence the snail?

Dr. Husting: We found eggs on the anal skin of infected children. These could hatch while swimming. It is therefore not necessary to defaecate directly into the water.

Dr. Shiff: You say that a latrine was associated with a lower incidence, whether or not it was used . . .

Dr. Husting: Latrines are simply one aspect of a better type of housing.

Prof. Allanson: Are the recommendations you made to be put into effect at Mazoe?

Dr. Husting: Yes.

Prof. Reinecke: I notice cowsheds were also associated with a low incidence —

Dr. Husting: Again cowsheds indicate a better type of housing.

Prof. Elsdon-Dew: What was the sex ratio of infection? Females more than males?

Dr. Husting: Yes.